

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

As rescanning documents *will not* correct images,  

---

please do not report the images to the  
Image Problem Mailbox.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/885,319	06/19/2001	Mark A. Stan	1613370-0006	4594

7470 7590 09/05/2003

WHITE & CASE LLP  
PATENT DEPARTMENT  
1155 AVENUE OF THE AMERICAS  
NEW YORK, NY 10036

20  
EXAMINER

MUTSCHLER, BRIAN L

ART UNIT

PAPER NUMBER

1753

DATE MAILED: 09/05/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/885,319

Applicant(s)

STAN ET AL.

Examiner

Brian L. Mutschler

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 21 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-5,8-13,16-23,26-34 and 37-53 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 12,13,16-19,21-23,26-30,32-34 and 37 is/are allowed.
- 6) ☒ Claim(s) 1-5,8-10 and 38-53 is/are rejected.
- 7) ☒ Claim(s) 11,20 and 31 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on July 21, 2003 has been entered.

### ***Comments***

2. The rejection of claims 1-5, 8, 10-13, 16, 18-23, 27, 31-34 and 37 under 35 U.S.C. § 103 over Ermer et al. in view of Weismann has been overcome by Applicant's amendment. Neither of the references teaches or suggests a solar cell having two diffusion regions, wherein the first diffusion region is shallow and contains more P than As, and the second diffusion region is deep and contains more As than P. Likewise, the rejections of claims 9, 17, 26, 28, 29 and 30 are also withdrawn.

### ***Claim Objections***

3. Claims 11, 20, 31, 38, 44 and 49 are objected to because of the following informalities:

- a. In claim 11 at line 3, please insert --is-- before "doped".
- b. In claim 11 at line 4, please delete the word "a" before "first".

Art Unit: 1753

- c. In claim 11 at line 7, please delete the word "the" before "P atoms".
- d. In claim 11 at line 7, please insert --atoms-- after "As".
- e. In claim 11 at line 8, please delete the word "the" before "As atoms".
- f. In claim 11 at line 9, please insert --atoms-- after "P".
- g. In claim 20 at line 6, please change "the dopants include" to --the dopant includes-- to maintain consistent language in the claim.
- h. In claim 31 at line 4, please change "the dopants include" to --the dopant includes-- to maintain consistent language in the claim.
- i. In claim 38 at line 11, please insert --the-- before "nucleation layer".
- j. In claim 44 at line 12, please insert --the-- before "nucleation layer".
- k. In claim 49 at line 12, please insert --the-- before "nucleation layer".

Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-5, 8-10 and 38-53 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation "wherein the n-type dopants in the first diffusion region includes phosphorus (P) atoms having a higher dopant concentration and the n-type dopants in the second diffusion region includes arsenic (As) atoms having a higher

dopant concentration" in lines 5-8. This limitation is indefinite because the relative terminology "higher dopant concentration" implies a comparison, but no comparison is made. It is suggested that the phrase be changed to --wherein the first diffusion region has a higher concentration of phosphorus (P) atoms than arsenic (As) atoms and the second diffusion region has a higher concentration of As atoms than P atoms--. The same applies to dependent claims 2-5 and 8-10.

Claim 38 recites the limitation "wherein the nucleation layer provides n-type phosphorus (P) atoms to the first diffusion sublayer" in lines 6-8 and the limitation "wherein the layer provides n-type As atoms to the second diffusion sublayer in response to the thickness of nucleation layer" in lines 9-11. These limitations are indefinite because the actual structure of the solar cell is unclear. The limitations recited above are process limitations defining the formation of the diffusion layers within the solar cell. However, the structure of the first diffusion sublayer and the second diffusion sublayer are not defined without a dopant, which is being provided by the nucleation layer and the other layer. In other words, it appears that the structure of the solar cell as claimed comprises a substrate, a nucleation layer and a layer; this structure is actually the precursor of the solar cell, i.e., a substrate which will have diffusion layers formed by the future diffusion of P atoms and As atoms from the nucleation layer and the other layer, respectively. The P atoms and As atoms in the recited structure are contained within the nucleation layer and the layer, respectively. Since the dopant atoms have not yet been provided, the diffusion sublayers are not yet diffusion sublayers. What is the actual structure of the solar cell? What is the structural

relationship between the dopant atoms and the nucleation layer and the other layer? Similar limitations appear in claims 44 and 49. It is suggested that the claims be revised to positively recite the structure of the solar cell and the relationships between the different features. The same applies to dependent claims 39-43, 45-48 and 50-53.

Claim 40 recites the limitation "the first diffusion sublayer includes the P atoms and As atoms" in line 2. Likewise, claim 42 recites the limitation "the second diffusion sublayer includes the P atoms and As atoms" in line 2. These limitations are indefinite because they imply that all of the P atoms and As atoms are contained within the first diffusion layer or the second diffusion layer, and are therefore contradictory. It is suggested that the phrases be changed to --the [first/second] diffusion sublayer includes P atoms and As atoms--. Similar phrases occur in claims 46, 47, 51 and 52.

Claim 41 recites the limitation "the P atoms in the first diffusion sublayer has the highest dopant concentration" in lines 1-2. This phrase is indefinite because it is not clear what the comparison is in reference to because there is no other dopant concentration recited and the term dopant has not been introduced or defined. It is suggested that the phrase be changed to --the first diffusion layer has a higher concentration of P atoms than As atoms--. Likewise, it is suggested that the similar phrase in claim 43 be changed to --the second diffusion sublayer has a higher concentration of As atoms than P atoms--. Similar phrases also appear in claims 46, 47, 51 and 52.

Claim 44 recites the limitation "the layer of GaAs" in lines 10-11. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the

Art Unit: 1753

phrase be changed to --the layer-- or else revised to provide proper antecedent basis for the layer being made of GaAs.

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 38-40, 44, 45, 48-50 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermer et al. (U.S. Pat. No. 6,380,601) in view of Wiesmann (U.S. Pat. No. 4,634,605) and in view of Stanbery (U.S. Pat. No. 4,322,571).

Regarding claims 38, 44 and 49, Ermer et al. disclose a multijunction solar cell having a germanium substrate **22** doped with an n-type dopant, a nucleation layer **34** comprised of indium gallium phosphide (InGaP), a second cell layer **36** of gallium arsenide (GaAs), and a third cell layer **44** of InGaP (col. 2, line 53 to col. 4, line 46). The nucleation layer **34** is formed at a preferred thickness of 25 Å to 500 Å and has a lattice parameter at a desired degree of lattice matching to the substrate **22** either "matched, or selectively made non-matching" (col. 3, lines 28-49). The solar cell of Ermer et al. would inherently absorb radiation ranging from UV radiation to a wavelength of 1800 nm through the use of Ge, GaAs and InGaP layers. Phosphorous is the preferred n-type dopant in the Ge substrate **22** (col. 3, line 1). The junction depth in the Ge substrate **22** ranges from 0.1 µm to 3 µm (col. 3, lines 7-10).

As subsequent layers are formed, the nucleation layer **34** would control the diffusion of dopant atoms into the substrate **22**. At the elevated temperatures at which the semiconductor layers are formed, solid state diffusion of dopants, such as arsenic from the GaAs layer **36**, would be controlled by the thickness of the nucleation layer **34**. Ermer et al. disclose "the invention allows for better passivation of the germanium homojunction substrate and shallower doping profiles with better control over diffused dopant concentrations" (col. 1, lines 63-66).

The method and apparatus of Ermer et al. differs from the instant invention because Ermer et al. do not disclose the following:

- a. First and second diffusion layers, as recited in claims 38, 44 and 49; and
- b. The use of arsenic and phosphorus as n-type dopants, as suggested in claims 38, 44 and 49 and recited in claim 40.

Regarding claims 38, 40, 44 and 49, Wiesmann discloses the use of both arsenic and phosphorous in combination as an n-type dopant (col. 7, lines 21-25). The use of arsenic and phosphorous as n-type dopants is very well known in the art, and they are functional equivalents of each other.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the dopant in the device and method of Ermer et al. to use both phosphorous and arsenic as taught by Wiesmann because phosphorous and arsenic are functional equivalents.

Regarding claims 38, 44 and 49, Stanbery discloses a method for forming a solar cell with a two-step diffusion profile. The solar cell has areas with a deep junction, which has a high thermal stability, an areas of shallow junctions, which have high light-to-electrical energy conversion efficiencies (col. 5, lines 64-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Ermer et al. and Wiesmann to use a two-step diffusion profile as taught by Stanbery because the two-step diffusion profile has high thermal stability and a high conversion efficiency.

***Allowable Subject Matter***

8. Claims 1-5 and 8-10 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.
9. Claims 11-13, 16-23, 26-34 and 37 would be allowable if rewritten to correct the objections to minor informalities set forth above.
10. Claims 1-5, 8-13, 16-23, 26-34 and 37 are distinguished over the prior art because they provide a solar cell, a method for controlling the diffusion within a solar cell and a method of fabricating a solar cell, where each provides a solar cell having both P atoms and As atoms as n-type dopants. The dopants are provided to create different regions within the solar cell, a shallow diffusion region comprising mainly P atoms and a deeper diffusion region comprising mainly As atoms. The prior art of record does not teach or suggest the formation of a solar cell comprising a shallow n-type region containing mainly P atoms and a deep n-type region containing mainly As

Art Unit: 1753

atoms. For example, Ermer et al. (U.S. Pat. No. 6,380,601) identify that P atoms diffuse more shallowly than As atoms, but desire only a single shallow region. Wiesmann (U.S. Pat. No. 4,634,605) teaches that a combination of P and As can be used, but does not teach or suggest the formation of two diffusion regions. Stanbery (U.S. Pat. No. 4,322,571) does recognize the advantages of using both a shallow doped portion and a deep doped portion, but the solar cell and method uses only a single dopant type and achieves the result by shaping the substrate after doping takes place. The instant invention provides a solar cell having two doped regions at different depths having different dopants and also provides a method for making such a cell utilizing the different diffusion rates of the dopant materials.

### ***Response to Arguments***

11. Applicant's arguments, in light of the amendments to the claims, have been persuasive in overcoming the rejections set forth in the prior Office action.

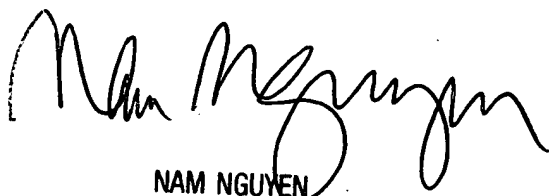
### ***Conclusion***

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 8:00am to 4:30pm.

Art Unit: 1753

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

A handwritten signature in black ink, appearing to read 'Nam Nguyen', is written over a rectangular stamp.

NAM NGUYEN  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700

blm  
August 28, 2003